

# M1D7:

## Complete data analysis using statistical methods

1. Library presentation
2. Prelab discussion
3. Complete statistical analysis
4. Data summary prep!

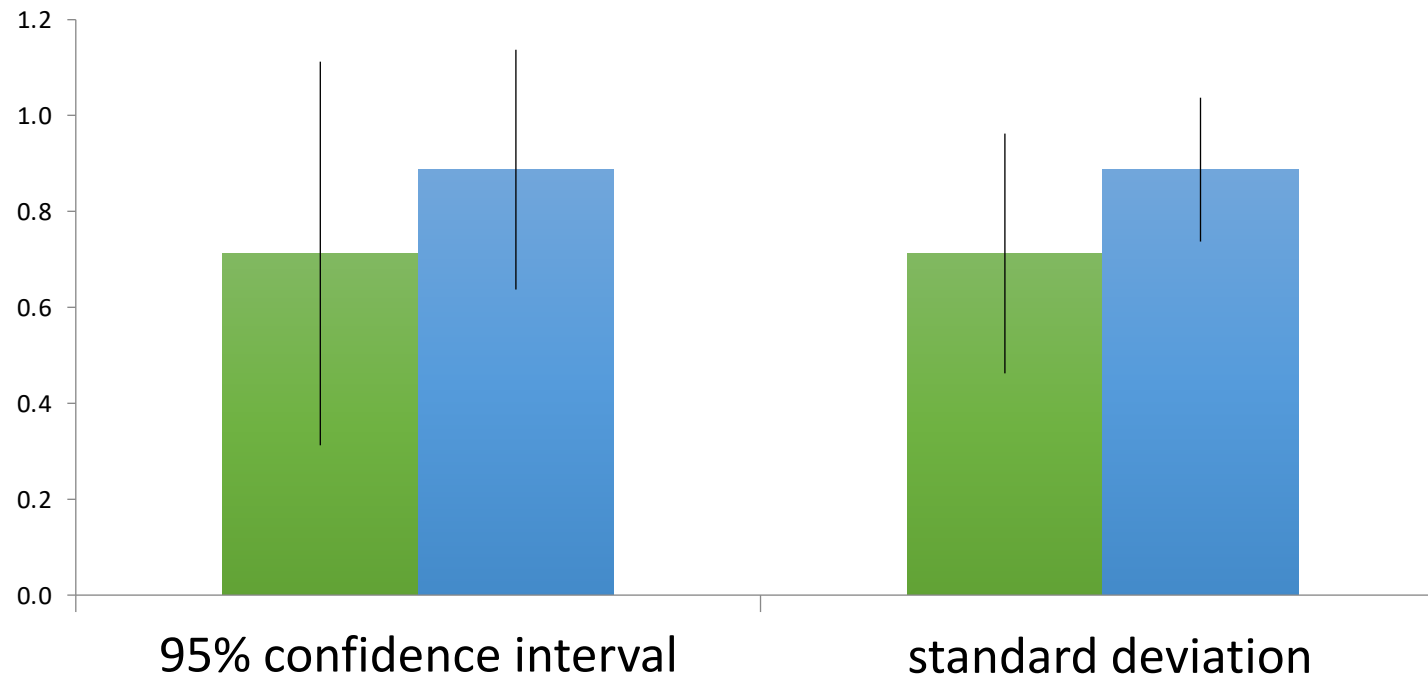
# Due dates are coming soon!

- **Data summary** (15%)
  - completed in teams and submitted via Stellar
  - draft due 10/4, final revision due 10/14
- **Mini-presentation** (5%)
  - completed individually and submitted via Gmail
  - due 10/11
- Laboratory quizzes (collectively 5%)
  - scheduled for M1D4 and M1D7
- Notebook (collectively 5%)
  - **Submit M1D4 to Aimee ([amoise@mit.edu](mailto:amoise@mit.edu)) by 10p tomorrow**
- Blog (part of 5% Participation)
  - due 10/5 via Blogspot



# Confidence intervals show variance in data

- At 95% confidence interval, there is a 95% chance that the true mean is within the defined range
- Error bars used to represent variance

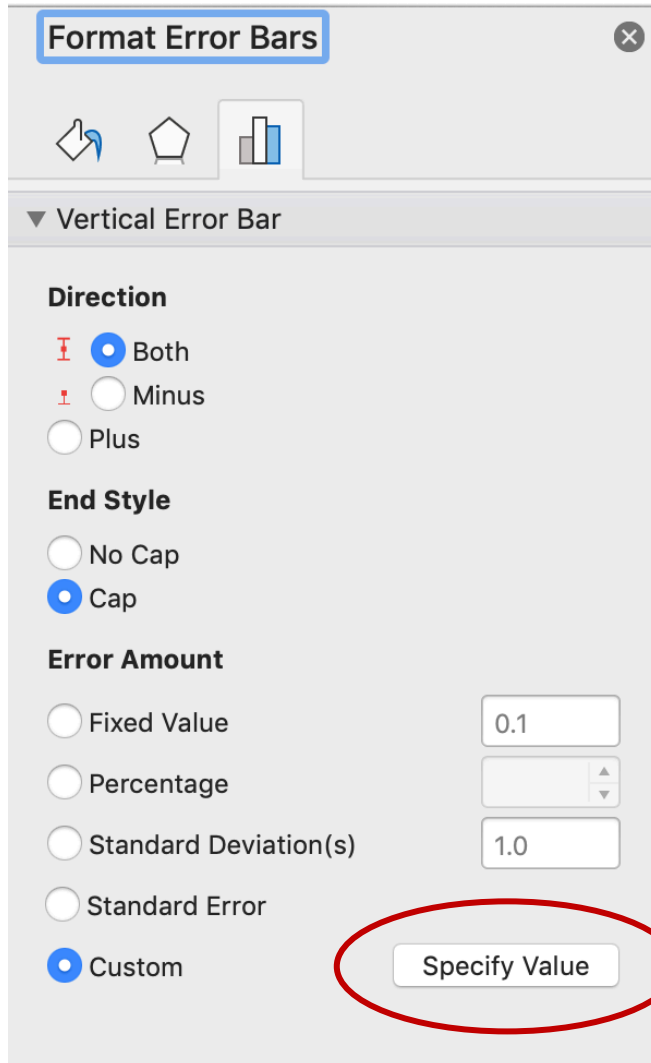


# Calculating confidence interval in Excel

= CONFIDENCE(confidence level, standard dev., size)

- Confidence level:
- Standard deviation:
- Size:

# How do you customize error bars in Excel?



The **Format Error Bars** dialog box is shown. It has a title bar with a close button. Below the title bar are three icons: a hand, a pentagon, and a bar chart. The **Vertical Error Bar** section is expanded. Under **Direction**, the **Both** radio button is selected. Under **End Style**, the **Cap** radio button is selected. Under **Error Amount**, the **Custom** radio button is selected. The **Specify Value** button is circled in red.

**Format Error Bars**

Vertical Error Bar

**Direction**

☒ Both  
☐ Minus  
☐ Plus

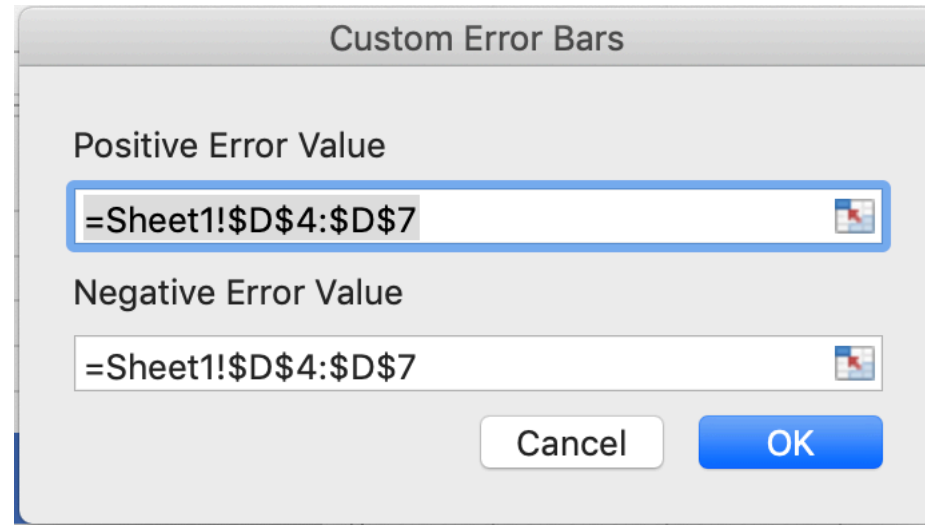
**End Style**

☐ No Cap  
☒ Cap

**Error Amount**

☐ Fixed Value 0.1  
☐ Percentage  
☐ Standard Deviation(s) 1.0  
☐ Standard Error  
☒ Custom

**Specify Value**



The **Custom Error Bars** dialog box is shown. It has a title bar. The **Positive Error Value** and **Negative Error Value** text boxes both contain the formula `=Sheet1!$D$4:$D$7`. The **OK** button is highlighted in blue.

**Custom Error Bars**

Positive Error Value  
=Sheet1!\$D\$4:\$D\$7

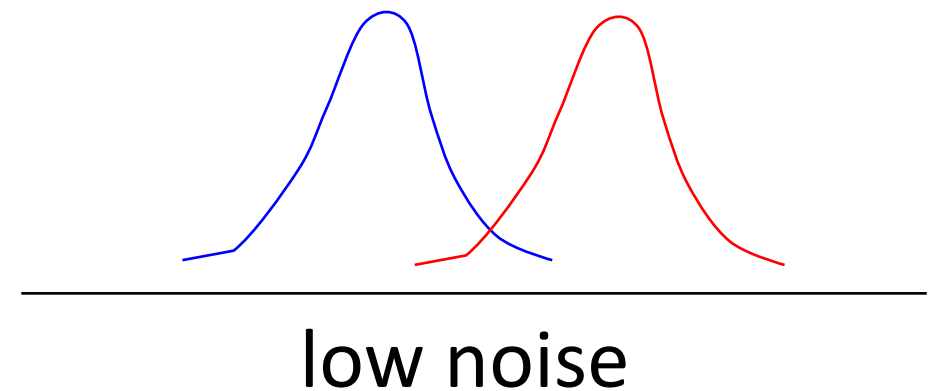
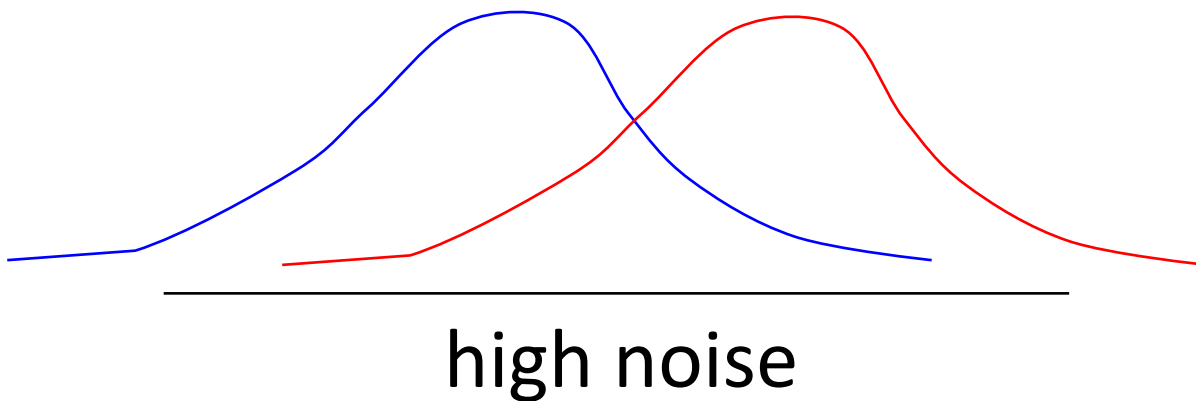
Negative Error Value  
=Sheet1!\$D\$4:\$D\$7

Cancel OK

Enter value calculated for confidence level as custom error bars

# Student's $t$ -test determines if populations are significantly different

- Assume data follows  $t$ -distribution
- At  $p < 0.05$ , there is less than a 5% chance that populations are the same (95% chance that populations are different)
- Examines signal (means):noise (variance) ratio

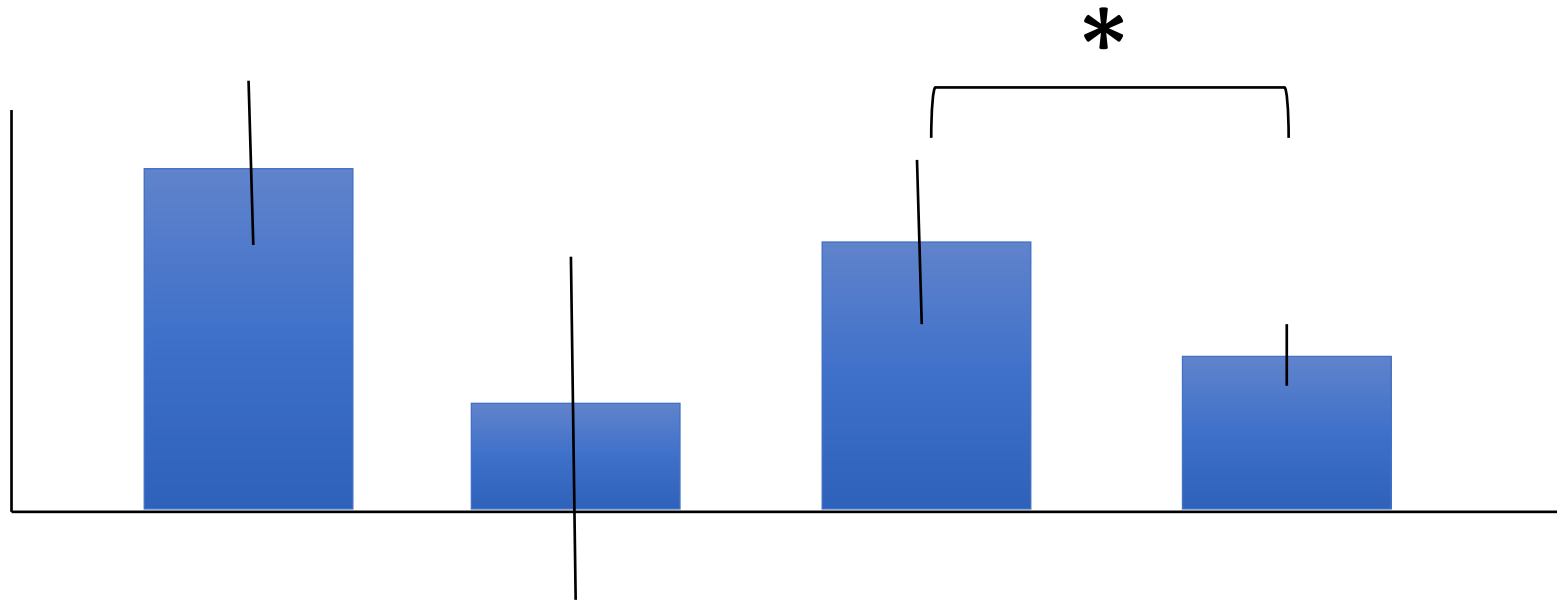


# Calculating Student's $t$ in Excel

$P = \text{TTEST}(\text{array1}, \text{array2}, 2, 3)$

- Arrays:
- 2 = two-tailed test:
- 3 = population variances not assumed:

# How will you statistics in your data analysis?



- Student's t-test can only be used to compare two populations
- What if data are not significant? Almost significant?



# Let's review our Mod 1 project goals...

What is our overall goal/question in this project:

What are the conditions we are using to address this:

# Let's review our Mod 1 experiments...

## $\gamma$ H2AX

How is damage indicated / shown?

What type of damage is measured?

Advantages?

Disadvantages?

## CometChip

How is damage indicated / shown?

What type of damage is measured?

Advantages?

Disadvantages?

# Making progress on the Data summary!

Title: take-home message

Abstract: **Paragraph, NOT in bullet points!**

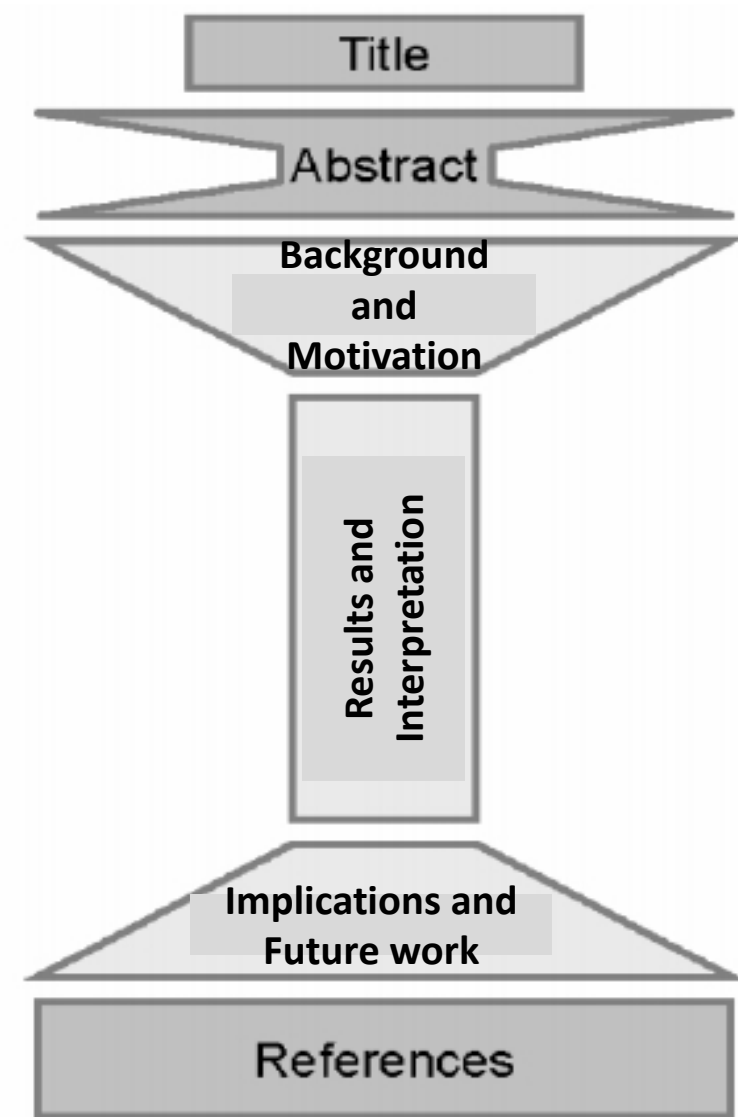
**In bullet points:**

Background and Motivation (include citations)

Results and Interpretation

Implications and Future work (include citations)

References (see wiki for format suggestions)



# Data summary structure / logistics

- To be submitted as a **powerpoint** file!
  - Change page settings such that 'slides' are portrait and 8.5" x 11"
  - Upload to Stellar (draft due Oct 4 at 10pm, revision Oct 14 at 10pm)
- Each figure will be included as a separate Data slide
  - Image should be at the top of the slide with title and caption
  - Results / Interpretation text should be included on same slide
  - Though figures are separated into Data slides, the story should be cohesive between figures!

# Review of Background & Motivation section...

- Impact statement
  - General background describing relevant / previous research
- Specific background (e.g. BER, H<sub>2</sub>O<sub>2</sub>, Arsenic, CometChip, H2AX)
  - Introduce topics (pathways, specific technologies, etc)
  - **Include BER pathway figure!**
  - Reference overview schematic figure
  - Narrow focus to the specific question addressed in your study
- Knowledge gap / statement of problem
  - State what is unknown
  - **Include your research question!**
  - What do you propose will be the outcome of your study?
- A brief preview of your findings
  - Here we show...
  - End with broad implications of the study

# Review of Results & Interpretations section...

- Figures and captions
  - **Organize figures logically!**
  - Use figure subpanels (label with letters)
  - Limit text on the image, move extra details / explanation to the caption
  - Use appropriately sized images
  - Include description title with take-home message
  - Include introductory sentence at start of caption
- Results and Interpretation (use subheaders)
  - **State the goal / intent / purpose of experiment in the first bullet**
  - What you did: experiments and expectations, describe controls
  - What you found: quantitatively describe your result, referring to the figure ("Figure 1a shows...")
  - What does this indicate: interpret your results, what does it mean?
  - What does this motivate you to do next: transition to next experiment

# Review of Implications & Future works section...

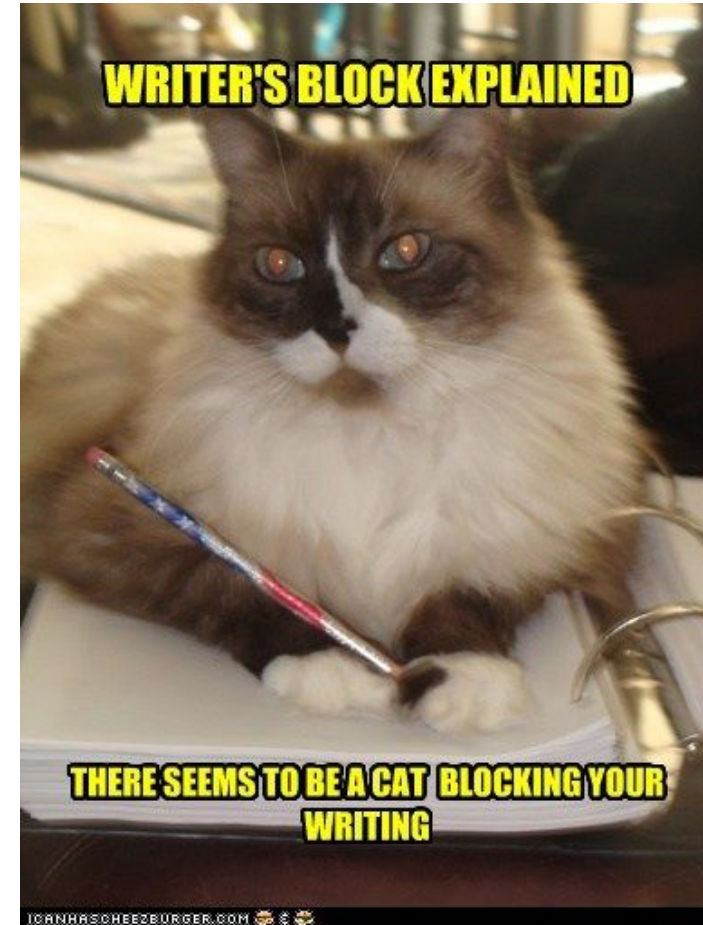
- Start with 'here we showed...'
  - **Restate major results and broad implications**
  - Follow same order as in Figures/Results
- Describe your conclusions from your data
  - If necessary, describe caveats of experiment and suggest improvements
- Identify unknowns and speculate (within reason)
  - Don't make huge generalizations or overreach
- Propose future experiments, identify new questions that arise
- **Come back to the big picture / impact statement topic introduced in background**

# For today...

- Apply statistical analysis to data
- Get a start on your Data summary!!

# For M2D1...

- Outline for Mini-presentation
- Read project overview for Mod 2





# Notes on Mini-presentation homework...

- Bullet / outline format
- Follow time and content guidelines:
  - Introduce yourself and your research project
  - Clearly state hypothesis to identify main question
  - Be quantitative when stating results (NOT “this was more/less than...”)
  - For now, use placeholder statements for key findings
- Logistics
  - Submission should not be edited / spliced
  - Ensure that you can be clearly heard in the recording
  - Be mindful of background distractions
  - [Submit video to course Gmail \(bioeng20.109@gmail.com\)](mailto:bioeng20.109@gmail.com)!

# Rubric for Mini-presentation

Category	Elements of a strong presentation	Weight
Introduction	<ul style="list-style-type: none"><li>• Introduce yourself and the research</li><li>• Summarize the background information necessary to understand the research</li><li>• Provide a clear and concise description of the central question / hypothesis</li></ul>	25%
Methods & Data	<ul style="list-style-type: none"><li>• Provide ONLY the method information necessary to understand the results</li><li>• Give complete and concise explanations of the results</li><li>• Relate the results to the central question</li></ul>	25%
Summary & Conclusions	<ul style="list-style-type: none"><li>• Highlight the key finding(s) relevant to the central question / hypothesis</li></ul>	25%
Organization	<ul style="list-style-type: none"><li>• Give a logical, easy-to-follow narrative</li><li>• Include transition statements</li></ul>	15%
Delivery	<ul style="list-style-type: none"><li>• Show confidence / enthusiasm and speak clearly</li><li>• Use appropriate language (technical or informal, as appropriate)</li><li>• Be mindful of the time limit (3 minutes +/- 15 seconds!)</li></ul>	10%